APPENDIX A
ENVIRONMENTAL HAZARD ASSESSMENT METHODOLOGY

A.1 HAZARD PROFILE

The environmental hazard assessment of chemicals consists of the identification of the effects that a chemical may have on organisms in the environment. An overview of this assessment process has been reported by Zeeman and Gilford (1993a). The effects are expressed in terms of the toxicity of a chemical on the organisms and are generally given as the effective concentration (EC) that describe the type and seriousness of the effect for a known concentration of a chemical. When the effective concentrations for a range of species for a chemical is tabulated, the tabulation is called a Hazard Profile or Toxicity Profile. A more detailed discussion of a comprehensive Hazard Profile has been presented by Nabholz, 1991. The most frequently used Hazard Profile for the aquatic environment consists of six effective concentrations as reported by Nabholz, et al., (1993a). These are:

- Fish acute value (usually a fish 96-hour LC_{50} value)
- Aquatic invertebrate acute value (usually a daphnid 48-hour LC_{50} value)
- Green algal toxicity value (usually an algal 96-hour EC_{50} value)
- Fish chronic value (usually a fish 28-day chronic value (ChV))
- Aquatic invertebrate chronic value (usually a daphnid 21-day ChV value)
- Algal chronic value (usually an algal 96-hour NEC value for biomass)

For the acute values, the LC_{50} (mortality) (EC_{50}) (effects) refers to the concentration that results in 50 percent of the test organisms affected at the end of the specified exposure period. The chronic values represent the concentration of the chemical that results in no statistically significant effects on the test organism following a chronic exposure.

The Hazard Profile can be constructed using effective concentrations based on toxicity test data (measured) or estimated toxicity values based on Structure Activity Relationships (SARs). The measured values are preferred, but in the absence of test data SAR estimates, if available for the chemical class, can be used. Thus the Hazard Profile may consist of only measured data, only predicted values, or a combination of both. Also, the amount of data in the hazard profile may range from a minimum of one acute or chronic value to the full compliment of three acute values and three chronic values.

In the absence of measured toxicity values, estimates of these values can be made using Structure Activity Relationships (SARs). SAR methods include Quantitative Structure Activity Relationships (QSARs), qualitative SARs or use of the best analog. The use of SARs by OPPT has been described (Clements, 1988; Clements, et al., 1994 in press). The use and application of QSARs for the hazard assessment of new chemicals has been presented (Clements, et al., 1993a). The development, validation and application of SARs in OPPT have been presented by OPPT staff (Zeeman, et al., 1993b; Boethling, 1993; Clements, et al., 1993b; Nabholz, et al., 1993b; Newsome, et al., 1993 and Lipnick, 1993).

The predictive equations (QSARs) are used in lieu of test data to estimate a toxicity value for aquatic organisms within a specific chemical class. Although the equations are derived from correlation and linear regression analysis based on measured data, the confidence interval associated with the equation are not used to provide a range of toxicity values. Even with measured test data, the use of the confidence limits to determine the range of values is not used.

A.2 DETERMINATION OF CONCERN CONCENTRATION

Upon completion of a hazard profile, a concern concentration (CC) is determined. A concern concentration is that concentration of a chemical in the aquatic environment which, if exceeded, may cause a significant risk. Conversely, if the CC is not exceeded, the assumption is made that probability of a significant risk occurring is low and no regulatory action is required. The CC for each chemical is determined by applying Assessment Factors (AsF) (USEPA 1984) to the effect concentrations in the hazard profile.

Assessment Factors incorporate the concept of the uncertainty associated with (1) toxicity data; laboratory tests versus field test and measured versus estimated data and (2) species sensitivity. For example, if only a single LC_{50} value for a single species, is available, there several uncertainties to consider. First, how good is the value itself? If the test were to be done again by the same laboratory or a different laboratory, would the value differ? Second, there are differences in sensitity (toxicity) among and between species that have to be considered. Is the species tested the most or the least sensitive? In general, if only a single toxicity value is available, there is a large uncertainty about the applicability of this value to other organisms in the environment and large assessment factor, i.e., 1000, is applied to cover the breadth of sensitivity known to exist among and between organisms in the environment. Conversely, the more information that is available results in more certainty concerning the toxicity values and requires the use of a smaller assessment factor. For example, if toxicity values are derived from field tests, then an assessment factor on 1 is used.

Four AsFs are used by OPPT to set a CC for chronic risk: 1, 10, 100, and 1000. The AsF used is dependent on the amount and type of toxicity data contained in the hazard profile and reflects the amount of uncertainty about the potential effects associated with a toxicity value. In general, the more complete the hazard profile and the greater the quality of the toxicity data, a smaller factor is used. The following discussion describes the use and application of the assessment factors:

1. If the hazard profile only contains one or two acute toxicity values, the concern concentration is set at 1/1000 of the acute value.

2. If the hazard profile contains three acute values (base set), the concern concentration is set at 1/100 of the lowest acute value.

3. If the hazard profile contains one chronic value, the concern concentration is set at 1/10 of the chronic value if the value is for the most sensitive species. Otherwise, it is 1/100 of the acute value for the most sensitive species.

4. If the hazard profile contains three chronic values, the concern concentration is set at 1/10 of the lowest chronic value.

5. If the hazard profile contains a measured chronic value from a field study, then an assessment factor of 1 is used.

A.3 HAZARD RANKING

Chemicals can be also be ranked according to hazard concern levels for the aquatic environment. This ranking can be based upon the acute toxicity values expressed in milligrams per liter (mg/L). The generally accepted scoring is as follows (Wagner, et al. 1995):

High Concern (H)	≤ 1
Moderate Concern (M)	> 1 and < 100
Low Concern (L)	> 100

This ranking can also be expressed in terms of chronic values as follows:

High Concern (H)	≤ 0.1
Moderate Concern (M)	> 0.1 and < 10.0
Low Concern (L)	≥ 10.0

Chronic toxicity ranking takes precedent over the acute ranking.

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APPENDIX B
EXPOSURE ASSESSMENT CALCULATIONS

This appendix presents the following model input data used for developing the exposure information presented in Chapter 3:

B.1 Sample Formulation Calculations for Modeling for 4 Chemicals
B.2 ISCLT Input File Example
B.3 BOXMOD Model Run For Sample Formulations for 2 Chemicals

B.1 SAMPLE FORMULATION CALCULATIONS FOR MODELING

B.1.1. Solvent Naphtha, heavy aromatic:

ISCLT Parameters:

Half-life in air: 2.5 days (from Fate Summary)
x 24 hours/day x 60 minutes/hour x 60 seconds/minute = 216,000 seconds

Release Rate for Single Facility:
0.02429 g/sec ÷ 100 m^2 = 0.0002429 = 2.4 x 10^{-4} g/sec/m^2

Model Result: 4.3 µg/m^3

Exposure calculations:

mg per year:
4.3 µg/m^3 x 20 m^3/day x 250 days/year ÷ 1000 = 21.5 mg/year ≈ 20 mg/year

Lifetime Average Daily Dose (LADD)
4.3 µg/m^3 x 20 m^3/day x 0.001 ÷ 70 kg = 1.2 x 10^{-3} mg/kg/day ≈ 1 x 10^{-3} mg/kg/day

BOXMOD Parameters:

DECAY = 0.693 ÷ 216000 = 3.21 x 10^{-6}

Time Constant= 1 ÷ DECAY = 216000 ÷ 0.693 = *311688*

Molecular Weight = 128

Release Rate for Denver:
0.02429 kg/site/day x 235 sites = 5.7 kg/day
5.7 kg/day ÷ 277130000 m^2 (277.13 km^2) = 2.1 x 10^{-8} g/sec/m^2

Model Result: 0.68 µg/m^3

Air Potential Dose calculations:

mg per year:
0.68 x 20 m^3/day x 250 days/year ÷ 1000 µg/mg = 3 mg/year

Lifetime Average Daily Dose (LADD)
0.68 x 20 m^3/day x .001 ÷ 70 kg = 1.9 x 10^{-4} mg/kg/day ≈ 2 x 10^{-4} mg/kg/day

B.1.2. Propylene glycol monobutyl ether

ISCLT Parameters:

Half-life in air: *14 hours*

14 hours x 60 minutes/hour x 60 seconds/minute = *50400 seconds*

Release Rate for Single Facility:

0.03815 g/sec ÷ 100 m^2 = 0.0003815 g/sec/m^2

Model Result: 4.7 µg/m^3

Exposure calculations:

mg per year:

4.7 µg/m^3 x 20 m^3/day x 250 days/year ÷ 1000 = 23.5 mg/year ≈ 20 mg/year

Lifetime Average Daily Dose (LADD)

4.7 µg/m^3 x 20 m^3/day x 0.001 ÷ 70 kg = 1.3 x 10^{-3} mg/kg/day ≈ 1 x 10^{-3} mg/kg/day

BOXMOD Parameters:

DECAY = 0.693 ÷ *50400* = *1.38 x* 10^{-5}

Time Constant = 1 ÷ DECAY = *50400*/0.693 = *72728*

Molecular Weight = 132

Release Rate for Denver:

0.03815 kg/site/day x 235 sites = 9.0 kg/day

9.0 kg/day ÷ 277130000 m^2 (277.13 km^2) = 3.2 x 10^{-8} g/sec/m^2

Model Result: 1.0 µg/m^3

Exposure calculations:

mg per year:

1.0 µg/m^3 x 20 m^3/day x 250 days/year ÷ 1000 = 5 mg/year

Lifetime Average Daily Dose (LADD)

1.0 µg/m^3 x 20 m^3/day x 0.001 ÷ 70 kg = 2.9 x 10^{-4} mg/kg/day ≈ 3 x 10^{-4}mg/kg/day

B.1.3 Fatty Acids, C_{16}-C_{18}, Methyl Esters

Water Release of 225.3 kg/site/year
Estimate of 94% removal during wastewater treatment

Daily Release:
225.3 kg/site/year ÷ 250 days/year = 0.9 kg/site/day

Daily Release after treatment:
0.9 kg/site/day x (1-0.94) = 0.05 kg/site/day

50th percentile mean flow of 499 million liters per day
0.05 kg/site/day x 1000 ÷ 499 million liters per day = 0.1 µg/L

Human Potential Dose via drinking water in mg/year:
0.1 µg/L x 2 L/day x 250 days/year ÷ 1000 = 5×10^{-2} mg/year

Human Potential Dose via fish ingestion:
Log BCF = 5.65; BCF = $10^{5.65}$ = 446,683
0.1 ug/L x 250 days/year x 16.9 g/day x 446,683 ÷ 1,000,000 = 189 mg/year
$\approx 2 \times 10^2$ mg/year

10th percentile mean flow of 66 million liters per day
0.05 kg/site/day x 1000 ÷ 66 million liters per day = 0.8 µg/L

Human Potential Dose via drinking water in mg/year
0.8 µg/L x 2 L/day x 250 days/year ÷ 1000 = 0.4 mg/year

Human Potential Dose via fish ingestion:
Log BCF = 5.65; BCF = $10^{5.65}$ = 446,683
0.8 µg/L x 250 days/year x 16.9 g/day x 446,683 ÷ 1,000,000 = 1510 mg/year
$\approx 2 \times 10^3$ mg/year

10th percentile low flow of 1 million liters per day
0.05 kg/site/day x 1000 ÷ 1 million liters per day = 50 µg/L

Denver Release Daily Release Amount:
225.3 kg/site/day x 235 sites ÷ 250 days/year = 212 kg/day

Denver Daily Release After Treatment:
212 kg/day x (1-0.94) = 12.71 kg/day

South Platte River Mean flow Stream Concentration:
12.71 kg/day x 1000 ÷ 875 million liters per day = 15 µg/L

Human Potential Drinking Water Ingestion in mg/year:
15 µg/L x 2 L/day x 250 days/year ÷ 1000 = 7.5 mg/year

Human Potential Fish Ingestion in mg/year:
15 µg/L x 16.9 g/day x 446,683 x 250 days/year ÷ 1,000,000 = 2.8×10^4 mg/year
$\approx 3 \times 10^4$ mg/year

South Platte River Low flow Stream Concentration:
12.71 kg/day x 1000 ÷ 590 million liters per day = 22 µg/L

B.1.4 Tetrapotassium pyrophosphate

Water Release of 25.2 kg/site/year

Estimate of 0% removal during wastewater treatment

Daily Release:
25.2 kg/site/year ÷ 250 days/year = 0.1 kg/site/day

Stream Concentrations:
50th percentile mean flow of 499 million liters per day
0.1 kg/site/day x 1000 ÷ 499 million liters per day = 0.2 µg/L

Human Potential Dose via drinking water in mg/year:
0.2 µg/L x 2 L/day x 250 days/year ÷ 1000 = 0.1 mg/year

10th percentile mean flow of 66 million liters per day
0.1 kg/site/day x 1000 ÷ 66 million liters per day = 1.5 µg/L

Human Potential Dose via drinking water in mg/year
1.5 µg/L x 2 L/day x 250 days/year ÷ 1000 = 0.8 mg/year

10th percentile low flow of 1 million liters per day
0.1 kg/site/day x 1000 ÷ 1 million liters per day = 1×10^{2} µg/L

Denver Release Daily Release Amount:
25.2 kg/site/day x 235 sites ÷ 250 days/year = 23.7 kg/day

Denver Daily Release After Treatment:
23.7 kg/day x (1-0.94) = 1.4 kg/day

South Platte River Mean flow Stream Concentration:
1.4 kg/day x 1000 ÷ 875 million liters per day = 1.6 µg/L $\approx$ 2 µg/L

Human Potential Drinking Water Ingestion in mg/year:
1.6 µg/L x 2 L/day x 250 days/year ÷ 1000 = 0.8 mg/year

Human Potential Fish Ingestion in mg/year:
1.6 µg/L x 16.9 g/day x 446,683 x 250 days/year ÷ 1,000,000 = 3.0×10^{3} mg/year

South Platte River Low flow Stream Concentration:
1.4 kg/day x 1000 ÷ 590 million liters per day = 2.4 µg/L

B.2 ISCLT INPUT FILE EXAMPLE

```
SITE 001 - SANBERN - Sample Formulation Single Facility in San Bernardino
 1 2 2 0 0 3 2 3 4 2 0 0-7-8-9 0 0 1 0 1 0 0 1 1 0
   1   0  30  16   0   1   6   5  16   0

    33.33    66.67   100.00   133.33   166.67   200.00   233.33   266.67
   300.00   333.33   366.67   400.00   433.33   466.67   500.00   533.33
   566.67   600.00   633.33   666.67   700.00   733.33   766.67   800.00
   833.33   866.67   900.00   933.33   966.67  1000.00
      0.    22.50
(7X,6F7.5)
  N      0.001580.000200.000000.000000.000000.00000
NNE      0.000730.000000.000000.000000.000000.00000
 NE      0.000210.000000.000000.000000.000000.00000
ENE      0.000080.000000.000000.000000.000000.00000
  E      0.000180.000000.000000.000000.000000.00000
ESE      0.000150.000000.000000.000000.000000.00000
 SE      0.000210.000000.000000.000000.000000.00000
SSE      0.000290.000000.000000.000000.000000.00000
  S      0.000550.000000.000000.000000.000000.00000
SSW      0.001150.000300.000000.000000.000000.00000
 SW      0.003930.001000.000000.000000.000000.00000
WSW      0.005670.001800.000000.000000.000000.00000
  W      0.014280.004600.000000.000000.000000.00000
WNW      0.010100.003400.000000.000000.000000.00000
 NW      0.005820.001600.000000.000000.000000.00000
NNW      0.002300.000400.000000.000000.000000.00000
  N      0.003510.000400.000100.000000.000000.00000
NNE      0.003190.000300.000000.000000.000000.00000
 NE      0.002430.000100.000000.000000.000000.00000
ENE      0.002590.000200.000000.000000.000000.00000
  E      0.004070.000200.000000.000000.000000.00000
ESE      0.002480.000200.000000.000000.000000.00000
 SE      0.002020.000100.000000.000000.000000.00000
SSE      0.001300.000200.000000.000000.000000.00000
  S      0.002390.000600.000000.000000.000000.00000
SSW      0.003180.000800.000300.000000.000000.00000
 SW       0.007580.003400.001600.000000.000000.00000
WSW      0.009880.005800.003200.000000.000000.00000
  W      0.022150.012400.007300.000000.000000.00000
WNW      0.012960.006100.002400.000000.000000.00000
 NW      0.006630.002500.000600.000000.000000.00000
NNW      0.002220.000600.000100.000000.000000.00000
  N      0.001070.000500.000900.000200.000100.00000
NNE      0.001460.000400.000400.000000.000000.00000
 NE      0.001990.000400.000100.000000.000000.00000
ENE      0.001920.000500.000000.000000.000000.00000
  E      0.003130.000700.000000.000000.000000.00000
ESE      0.001730.000300.000100.000000.000000.00000
 SE      0.001780.000500.000200.000000.000000.00000
SSE      0.001190.000500.000200.000000.000000.00000
  S      0.000970.000500.000400.000000.000000.00000
```

```
SSW  0.001160.000600.000600.000000.000000.00000
 SW  0.002960.002200.002900.000100.000000.00000
WSW  0.004290.003900.008400.000400.000000.00000
  W  0.007670.006400.020900.000900.000000.00000
WNW  0.002830.002300.004000.000300.000000.00000
 NW  0.001280.000700.000900.000000.000000.00000
NNW  0.001100.000800.000500.000000.000000.00000
  N  0.002800.001200.001300.004800.002400.00060
NNE  0.001900.000900.000700.003200.001500.00080
 NE  0.001940.001200.000300.000700.000200.00010
ENE  0.003070.001900.000400.000100.000000.00000
  E  0.009610.003800.001300.000200.000000.00000
ESE  0.007900.002900.001600.000100.000000.00000
 SE  0.006660.002500.001800.000400.000000.00000
SSE  0.003620.001400.000800.000400.000000.00000
  S  0.003350.001500.001000.000200.000000.00000
SSW  0.003580.001300.001000.000300.000000.00000
 SW  0.009760.004200.003600.001300.000000.00000
WSW  0.016040.007400.008000.003900.000100.00000
  W  0.026460.013000.018300.010100.000100.00000
WNW  0.007520.003700.002500.000800.000000.00000
 NW  0.003720.001600.000900.000800.000000.00000
NNW  0.002300.001100.000700.001400.000200.00000
  N  0.003700.001200.001700.000000.000000.00000
NNE  0.009260.002500.001500.000000.000000.00000
 NE  0.028130.009000.000600.000000.000000.00000
ENE  0.036010.010100.000600.000000.000000.00000
  E  0.057860.011300.000500.000000.000000.00000
ESE  0.036440.005100.000000.000000.000000.00000
 SE  0.024540.002800.000000.000000.000000.00000
SSE  0.008130.001500.000000.000000.000000.00000
  S  0.006850.001200.000100.000000.000000.00000
SSW  0.003970.000700.000100.000000.000000.00000
 SW  0.013900.004000.000800.000000.000000.00000
WSW  0.037200.014100.004000.000000.000000.00000
  W  0.062430.023800.009400.000000.000000.00000
WNW  0.008390.002400.000700.000000.000000.00000
 NW  0.002870.000800.000100.000000.000000.00000
NNW  0.002090.000900.000500.000000.000000.00000
   294.10   294.10   294.10   291.00   287.90   287.90
  1728.00
  1152.00
  1152.00
   843.00
   534.00
     0.00
     0.00
     0.00
     0.00
     0.02
     0.00     0.00     0.00     9.800.00000321
      1.5      2.5      4.3      6.8      9.5     12.5
     0.00    22.50    45.00    67.50    90.00   112.50   135.00   157.50
   180.00   202.50   225.00   247.50   270.00   292.50   315.00   337.50
```

```
0.15000001
0.15000001
      0.2
     0.25
0.30000001
01011020      0.00      0.00   3.00        10.00         0      0.0002429
```

B.3 BOXMOD MODEL RUN FOR SAMPLE FORMULATION

B.3.1 Solvent Naphtha

* * * * GAUSSIAN BOX MODEL INPUT * * * *

Latitude 39.49.30. Longitude 104.57. 0.
Area Width (km) = 1.66E+01
Emission Rate (g/m**2/s) = 2.10E-08
Time Constant (s) = 3.12E+05
Precipitation Rate (mm/hr) = 1.22E+00
Precipitation Frequency = 4.30E-02
STAR station 0618 - DENVER/STAPLETON CO
Molecular Weight = 1.28E+02

* * * * GAUSSIAN BOX MODEL RESULTS * * *

Scavenging Coeff (1/s) = 6.01E-05
Deposition Speed (m/s) = 7.00E-03
Concentration (ug/m**3) = 6.77E-01

B.3.2 Propylene Glycol

* * * * GAUSSIAN BOX MODEL INPUT * * * *

Latitude 39.49.30. Longitude 104.57. 0.
Area Width (km) = 1.66E+01
Emission Rate (g/m**2/s) = 3.20E-08
Time Constant (s) = 7.27E+04
Precipitation Rate (mm/hr) = 1.22E+00
Precipitation Frequency = 4.30E-02
STAR station 0618 - DENVER/STAPLETON CO
Molecular Weight = 1.32E+02

* * * * GAUSSIAN BOX MODEL RESULTS * * *

Scavenging Coeff (1/s) = 5.92E-05
Deposition Speed (m/s) = 7.00E-03
Concentration (ug/m**3) = 9.99E-01

APPENDIX C
LITHOGRAPHIC PERFORMANCE DEMONSTRATION METHODOLOGY

This chapter presents information on the methods that were used to gather the performance demonstration data at the print shops and in the laboratory, as presented in Chapters 4 and 7. Specifically, this appendix includes:

C.1 Characteristics to be Reported Out of the Performance Demonstration
C.2 Demonstration Methodology
C.3 Blanket Swell Test (laboratory test)
C.4 Washability/wipe Test (laboratory test)

C.1 CHARACTERISTICS TO BE REPORTED OUT OF THE PERFORMANCE DEMONSTRATION

C.1.1 Cost of Each Product as Utilized

Product Cost

Interested product suppliers should include the manufacturer's suggested retail price (to the end user) of their products ($ per 5 gallon drum) upon submission of samples for demonstration so that the cost per volume used in a cleaning cycle can be determined and reported.

Disposal/Spoilage Costs

Suppliers should provide specific recommendations for the disposal or treatment of wastes associated with using their products. Based upon these recommendations and the wastes determined in the field tests, disposal or treatment costs will be estimated.

Labor/Down-time Costs

This information will be based on the time required to wash a standard 19" X 26" blanket (based on two measures: button-push to completion of wash excluding time for other activities, such as refilling paper; and, after washing, zero the counter and count the number of sheets to get back to salable printing), a standard press operator wage, and standard press time costs. The costs of time and paper losses while returning to salable printing following the wash should be included here as well as any costs that may be associated with changes in or destruction of the blanket or other printing system components. The standard press operator wage information will be obtained from the wage and hourly survey developed by the National Association of Printers and Lithographers.

Storage Costs

These costs will include any special storage required due to hazardous components present in the blanket wash materials.

C.1.2 Product Constraints

The blanket wash supplier should provide information about product compatibility with specific inks (e.g. petroleum or vegetable oil based, UV water based), if known. If the supplier does

not provide information regarding product incompatibilities, it will be assumed that there are none.

C.1.3 Special Safety Storage Requirements

Suppliers should provide information about the flammability (as measured by flash point) of the product. This will be confirmed by the laboratory test in the pre-screening procedure.

C.1.4 Ease of Use

The physical effort required to effectively clean the blanket using the test product will be evaluated and reported. This is a subjective judgement based on the experience of the press operator.

C.1.5 Duration of the Cleaning Cycle

The measured time will be the entire cleaning cycle from press shut down to completion of the cleaning process (this excludes any activity unrelated to blanket cleaning). This information when correlated with labor and press-time costs will attempt to measure the total costs associated with the use of the product.

C.1.6 Effectiveness of the Blanket Wash Solution

This will be the subjective judgement of the press operator. The basic criteria will be whether the blanket is sufficiently clean to resume printing based on the judgement of the operator. VM&P Naphtha will be used as the baseline blanket wash to measure a test solution's efficacy, and the operator should also compare against what is normally used on the press.

C.1.7 Printing Equipment and Ink

Information will include the manufacturer, type and age of the press, the blanket and the ink, and the length of press run prior to blanket wash.. This is basically descriptive information that may assist in discovering and reporting incompatibilities between the blanket washes and equipment or inks. Additionally, the type of printing job, type of fountain solution, paper size relative to press size, paper type, brief description of blanket condition (Note: the blanket used should be runable with no smashes or repairs) along with a general description (light, medium, and heavy) of ink coverage will also be reported.

C.2 DEMONSTRATION METHODOLOGY

C.2.1 Product Pre-Screening and Masking

The project will demonstrate alternative blanket washes. Products, product information and Material Safety Data Sheets (MSDS) will be submitted by suppliers in properly labeled generic commercial containers to an independent laboratory (e.g. Graphic Arts Technical Foundation (GATF) or university). The independent laboratory will test the flash point and volatile organic chemical (VOC) content of the alternative blanket washes. The vapor pressure of the product will be submitted by the supplier (the supplier will note whether the vapor pressure is based on a calculation or test data.) The pH of the product will be provided by the supplier and will be verified by the laboratory. Suppliers wishing to participate in the performance demonstration will have to make direct arrangements with the independent laboratory.

The laboratory will mask all products by removing the trade names and manufacturer from the containers and assign each sample a random ID number. Suppliers will provide a masked MSDS in addition to the standard MSDS sent for shipping. They will also give directions for use of the product without any identifying names, labels or characteristics.

The laboratory will perform a standard test for blanket swelling potential of each product. They will also perform a washability/wipe test for cleaning effectiveness on all of the products submitted. The blanket swell test and the washability/wipe test proposed methodologies are attached. The directions for each specific product will be used as much as possible, including the manufacturer's directions for dilution or mixing. Any deviation from the manufacturers directions will be noted along with the reasons for the deviation. Only products that pass this functional demonstration stage will be used in the field demonstration portion of the project.

Based on the results of the product pre-screening, products will be grouped into categories based on their formulation and/or chemical parameters. These categories should be consistent with the categories used in the EPA risk assessment. One or more products successfully completing the screening will be chosen to "represent" each of the categories; these representatives (one or two per category) will be from the average of the class. The selection of masked products will be sent to volunteer printers for field demonstration. The selection of printers will take into account the type of inks being used as well as the sizes and types of blankets. The variety of inks and blankets used for the demonstration will depend on the number of demonstration sites. Each printer will test a limited number of products. This number will be determined when the number of volunteer printers is established. Although contingent upon the number of categories, the number of volunteer printers, and available resources, each representative blanket wash will be field demonstrated by at least two.

C.2.2 Documentation of Existing Conditions at Volunteer Facility

Once the products have been shipped to the volunteer printing facilities, an observer[a] will record the type, color, and manufacturer of the ink currently being used on the press. The observer will also document the type, model, and condition of the press and blanket being used for the demonstration and the type of paper being run on the press. The observer will also briefly describe the experience of the press operators participating in the test and will document any past experiences that the printer has had with the demonstration of blanket washes; the observer will note any potential biases. The current waste and wipe disposal practices and costs will be documented by the observer. **NOTE:** Presence of observer should be cleared with insurance carrier if necessary, and the purpose of the observer should be carefully explained to the personnel in the pressroom.

The observer will record the product name and cleaning procedure for the blanket wash currently used by the company. The observer will record the cost of the current blanket wash solution. The observer will also record how the product is being stored (in bulk and at the press) and disposed of as waste.

The observer will document the current practices by observing the clean up of a blanket, utilizing the company's current product. This will include any pre-application dilution of the product. The observer will measure the quantity used for the cleaning with the company's current

[a] *A contract is currently being prepared by EPA to staff this function. This observer will not provide technical assistance to the printers. The observer will serve to document the demonstration and record the operators observations. The observer will ensure the operator performs the demonstration according to the final approved methodology. The observer will additionally serve as the press operators conduit to the technical assistance personnel. This conduit is necessary so as to clearly document the direction given and the actions taken.*

blanket wash solution and record the time required for the cleanup. The pressman will use a clean rag to clean the blanket, and the observer will record the size and weight of the rags used for cleaning before and after the cleaning. This will provide an estimate of the retention factor of the product.

The observer will describe the density of the image currently being printed and will record information on the relative frequency of blanket cleaning. The observer will document the number of images required to obtain an acceptable print.

C.2.3 Establishing Evaluation Baseline at Volunteer Facility

The blanket will be cleaned by the press operator using the baseline solution (VM&P Naphtha). This initial cleaning will serve to familiarize the press operator with the baseline product performance. The printer will compare the baseline solution with the blanket wash that is typically used. It has been suggested that this initial cleaning should not be used for comparative purposes, but the information noted below in Section B.2.4 should be noted for reference in any case.

C.2.4 Demonstration

The press will then be restarted for printing and then stopped for cleaning according to the company's standard procedures. The observer will measure the time of cleaning from button push to completion of wash excluding time for other activities, such as refilling paper, and will ask the press operator to zero the counter in order to count the number of sheets to get back to salable printing. The observer will document the volume of baseline solution used and describe the procedure used to ensure the directions were adhered to by the operator. This procedure will be followed for three complete cleaning cycles.

C.2.5 Press Operator Evaluation

At the completion of these cycles the press operator will subjectively evaluate the condition of the blanket, i.e., scaling, picking, etc. Additionally, the operator will evaluate the ease of use and performance of the baseline solution. The observer will describe the density of the image currently being printed. The observer will document the number of images required to obtain an acceptable print image for each of the cleaning cycles.

C.2.6 Resetting the Blanket

The blanket will be cleaned by the press operator using the test blanket wash solution. This initial cleaning will serve to familiarize the press operator with the product and to avoid complications with the previously used solutions. The press operator should measure the volume after each cleaning (the volume used in the initial cleaning may not be used for comparative purposes).

C.2.7 Demonstration

The press will be restarted for normal operation and then be stopped for cleaning according to the company's standard practice. The observer will measure the time of cleaning from button push to completion of wash excluding time for other activities, such as refilling paper, and will ask the press operator to zero the counter in order to count the number of sheets to get back to salable printing. The observer will document the volume of solution used and describe the procedure used to ensure the directions were adhered to by the operator. This procedure will be followed for five complete cleaning cycles.

C.2.8 Press Operator Evaluation

At the completion of these cycles the press operator will subjectively evaluate the condition of the blanket, i.e., scaling, picking etc. Additionally, the press operator will document the density of the last printed image. The press operator will document the number of images required to obtain an acceptable print image for each of the cleaning cycles. The press operator will compare the relative performance of the test solution as compared to the baseline solution.

C.2.9 Long Term Test

After completion of the above demonstration, a longer term test will be performed by the printer. This test will consist of continued use of the supplied product for a period of one week. The blanket will not be cleaned with any other solutions until the observer returns. The press operator will record the total number of copies printed, the number and relative frequency of blanket washes performed, the volume of product used for each blanket wash, the total amount of product used, and the number of images required to obtain an acceptable print quality for each cleaning cycle.

At the completion of this phase, the observer will return to the shop and will record the press operator's data. The observer will then document the procedures used in a final cleaning of the blanket by the press operator. This will indicate whether there has been any deviation from the initial cleaning procedure by the press operator. If there has been a deviation the observer shall record the reasons for the deviation.

The press operator will then evaluate the condition of the blanket and describe the density of the product currently being printed.

If at any time during this phase of the demonstration there is problem with the solution or the press, the press operator or company point of contact will document the problem as specifically as possible and call the technical assistance provider[b] for guidance. Any corrective action will be documented by both the technical assistance provider and the press operator. The observer will record the actions documented by the press operator.

C.2.10 Trouble Shooting

If problems arise during the field demonstration of the blanket solutions, the following procedures will be followed. If the observer is present, the problem will be documented and the observer will call the technical assistance provider for guidance. If the observer is not present the press operator will document the problem and contact the technical assistance provider.

The technical assistance provider will first review the procedures used by the press operator to ensure they are in compliance with the instructions provided with the product. If the procedures are correct then the technical assistance provider will contact one of the printers currently using a product in that category for assistance. Names of these support printers will be provided by the suppliers of the products. The technical assistance provider will relay and filter the recommendation of the support printer to the press operator. The technical assistance provider will ensure the confidentiality of the products is maintained during this period. The identity of the product in the field will remain masked, and the identity of the specific product being used by the support printer providing guidance will not be asked or provided by the printer.

[b] *A contract will be prepared by EPA to staff this function. The technical assistance provider (i.e., GATF, university, etc.) will be available to trouble-shoot during the field demonstration portion of the project.*

The observer and/or the technical assistance provider will document all actions recommended and taken.

If the recommendations provided by the technical assistance provider are unsuccessful, the press operator will then attempt to solve the problem. The observer and/or the technical assistance provider will document the actions taken by the press operator and the success or failure of the actions.

The above procedures will be repeated for each product tested at the printer test site.

C.2.11 Results and Final Report

Final results will be assembled from the test sites and provided to a contractor to develop into a final report. The report will be developed so that the blanket wash products submitted for testing are grouped according to their formulations/chemical parameters (e.g., VOC content, vapor pressure). The results from similar products in a grouping will be reported in ranges so that the scope of performance from each group can be reported in the information provided to printers. The parameters delineating the grouping will be clearly defined so that both printer and supplier can determine the grouping for any particular blanket wash of interest. Special attention will be paid to the report-out of information on water-miscible products so that printers realize that the category characteristics are based on the use of proper amounts of water. [Note: No results will be provided for individual/named products, but blanket washes participating in the study will be listed in the report, along with their grouping.] Results from the field demonstration will be evaluated and assembled so that for any particular group the "average" experience with the products in the group is presented, along with the extreme reactions.

The report will thus have two parts. One part that presents the independent laboratory's screening and other information founded in essentially concrete or quantitative data and a second part that gives experiential anecdotes derived from the subjective evaluations of the demonstration site personnel. Both types of information can be used to develop a second type of information product: case studies of individual demonstration locations that discuss specific actions, changes in techniques, attitude adjustments or other factors that could be significant to a printer that is contemplating product substitution. The products would continue to be masked in the case study. It may be possible to combine several sites with similar experiences into a single report focussing on a single group of products.

C.3 BLANKET SWELL TEST

The purpose of this test is to determine the effect of blanket washes on lithographic blankets by measuring any change in thickness by the use of a micrometer.

Equipment:

Crystallization Dish
Cady Gauge (gauge +/- 0.0005 inch)
Swell Test Clamp
2 x 2 inch squares compressible blankets
VM&P Naphtha, Varnish Makers' and Painters' Naphtha; petroleum fractions meeting ASTM specifications. (Distillation range, at 760mm Hg 5% at 130°C; greater than 90% at 145°C)
Various Blanket Washes

Experimental Procedure:

This procedure involves measuring and adding 10 ml of the blanket wash to a crystallization dish using a graduated cylinder. An initial caliper measurement is taken of the 2 x 2 inch blanket sample and then it is placed over the mouth of the dish. The dish and blanket are placed into the swell clamp where the blanket is tightened down onto the mouth of the dish until a leak proof seal is formed. The various washes are kept in contact with the blanket for one hour. Caliper readings are taken and the percent swell is calculated. The blanket is re-tightened, exposed for an additional five hours, and the caliper is measured again. This same procedure will be repeated for each blanket wash. The VM&P Naphtha will be used as a control.

$$\text{Percent Swell} = \frac{\text{Final Caliper - Initial Caliper}}{\text{Initial Caliper}} \times 100$$

Sample	% Caliper Change After 1 Hour	% Caliper Change After 6 Hours
1. Control (VM&P Naphtha)		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

Temperature _____

Relative Humidity _____

Blanket Type _____

C.4 WASHABILITY/WIPE TEST

Equipment:

Ink - Sheetfed Process Black
Blanket - Compressible Blanket Cut Into Squares
Quickpeek Brayer Apparatus
Gardner Scrubber Apparatus
Graduated Cylinder
Control Blanket Wash - VM&P Naphtha
Playtex® Panty Shield
Status T Reflective Densitometer
Standard 1200-1500 Watt Blow Dryer
Various Candidate Blanket Washes

Experimental Procedure:

The procedure involves an initial evaluation by using both a dry and wet ink film drawn down on separate pieces of blanket using a quickpeek brayer apparatus. The ink stripes will measure 2 inches wide and five inches in length. The amount of ink applied will be determined by using one small or large hole on the Quickpeek apparatus. The blanket will be new and cleaned with the standard prior to applying the ink films. One of the ink films will be dried with a standard blow dryer.

The piece of blanket will then be placed into the holder of the Gardener Scrubber Apparatus. A measured volume of standard and candidate washes will be evaluated. The number of strokes necessary to clean the blanket with the standard will be determined. Once the area has been cleaned with the standard, the densitometer will be used to evaluate the cleanliness of the blanket. Each candidate wash will be placed onto a clean Playtex® Panty Shield and the cleanliness of the blanket will be measured after the same number of strokes found necessary by the standard. if the blanket is not clean, the number of strokes necessary to clean the blanket will be noted. Any residue or other unusual conditions will be indicated.

One of the wet ink films will be dried for 20 minutes with the blow dryer. The same volume of standard and blanket wash as used for the wet ink will be use. The above procedure will be repeated.

The following represents a more detailed review of the step-by step procedure for the Gardner Scrubber Apparatus:

1. A piece of blanket is cut to fit into the holder of the Gardener Scrubber apparatus and the section to be scrubbed is drawn on the blanket. A measured quantity of ink is spread evenly onto the surface of the blanket, insuring that the thickness of the ink is uniform in the area to be scrubbed. Inking should be done on a counter or other level surface - inking in the holder will result in an uneven surface.

2. The wooden block is used to hold the sample collector, in this case a Playtex® Panty Shield. A new, dry shield should be weighed, without the coated paper that protects the adhesive. Solvent will be placed on the shield, not on the inked surface. The initial weight of the shield should be noted and the shield placed on the wooden block. Affix the shield on the side of the block not marked "top" block using the shield's adhesive, and place the block in its holder. Make sure the shield ends are inside the metal holder. They can be

forced in by hand or held with thumbtacks. Use the side screw to insure the block is held securely.

3. Prepare a pipet with 0.4 mL of standard solvent. Insure that the Scrubber counter is reset and that the holder is in a position where it can be stopped after the test. The far right hand side of the tray is suggested.

4. Place the inked blanket into the tray. Hold the wooden block with the panty shield up and away from the inked surface so that no ink gets on the panty shield. Pipet the wash onto the pad using a swirling motion to evenly distribute the solvent over the surface.

5. Turn the pad over and start the scrubber. It should be allowed to go back and forth 20 times. At the completion of the last cycle, lift the pad off the blanket surface.

6. Lift the tray and blanket out of the apparatus.

7. Remove the block holder and remove the panty shield. Place in a 110 C forced draft oven for 2 hours to drive off the solvent. Weigh the dried panty shield and note the weight.

8. Clean the piece of blanket and re-ink to perform more tests.

9. Complete the tests for the blanket wash materials being tested with 2 replications each. Repeat the test using the standard solvent upon completion of the test series.

Note: A modified method may need to be developed for aqueous cleaners.

APPENDIX D
PERFORMANCE DEMONSTRATION OBSERVER SHEETS

The following four forms (shown on the following pages) were used by the observers and printers to record information for the performance demonstrations:

D.1 Observer's Evaluation Sheet
D.2 Observer's Performance Evaluation Sheet
D.3 Printer's Evaluation Sheet
D.4 End-of-Week Follow-up Questionnaire

D.1 OBSERVER'S EVALUATION SHEET

FACILITY NAME: _____ **DATE:** _____

Ask each participating printer in the substitute blanket wash performance demonstrations, to answer these questions when you call to schedule your visit to their facility. Once on-site, verify the answers.

1. Printing process

Approximately what percentage of your business (based on annual sales) is in the following segments? Please check all boxes that apply.

	<50%	**50 - 95%**	**95 - 100%**
Lithography/Offset	☐	☐	☐
Gravure	☐	☐	☐
Flexography	☐	☐	☐
Screen printing	☐	☐	☐
Letterpress	☐	☐	☐
Other (specify)	☐	☐	☐

2. Products

What percentage of your *lithography* business (based on annual sales) is in the following products? Please check all boxes that apply.

	<50%	**50 - 95%**	**95 - 100%**
Commercial Printing	☐	☐	☐
Direct-mail Products	☐	☐	☐
Business Forms	☐	☐	☐
Publications (other than news)	☐	☐	☐
Packaging	☐	☐	☐
News	☐	☐	☐
Other (specify)	☐	☐	☐

3. General Facility Information

How many employees are at this location? _____

How many employees work in the press room? _____

How many shifts does your facility run per day? _____

4. Press Type(s)

Describe the press(es) that will be used for the performance demonstrations. The required press size is in the 19" x 26" class.

1. Press size: _____ *(in. x in.)* **# of print units:** _____ **Print speed:** _____ *(# impressions/hour)*

2. Press size: _____ *(in. x in.)* **# of print units:** _____ **Print speed:** _____ *(# impressions/hour)*

5. Blanket information

On the press(es) that will be used for the demonstration, what is the average number of times a blanket is washed per shift? _____

What type of blanket do you use on the press(es) that will be used for the demo:

- Manufacturer: _____

- Type (e.g., 3-ply compressible, etc.) _____

- Number of impressions on this blanket prior to the demonstrations:
  1 week or less...☐ 1 week to 3 months...☐ 3 months or more...☐

- Do you have any automatic blanket washers in your facility? _____

6. Blanket Washes

Press Used in Demo.	**Trade Name of Blanket Wash/Manufacturer**	**Cost ($/gallon)**	**Dilution Ratio (wash:water)**	**Ink Type(s)**
				conventional ☐ vegetable oil-based ☐ UV ☐ waterless ☐ other_____ ☐
				conventional ☐ vegetable oil-based ☐ UV ☐ waterless ☐ other_____ ☐

7. Experience with Substitute Blanket Washes

a. Have you tried any substitute blanket washes for environmental or worker health and safety reasons?

- Did the substitute wash work better, the same, or worse than your old wash? Why?

b. Besides substitute washes, have you changed any equipment, procedures or work practices that reduced your use of blanket wash solution or reduced the time required to wash the blanket? Yes.....☐ No.....☐ - If yes, please describe:

8a. Cleaning Procedure - CURRENT PRODUCT

Record blanket cleaning procedure using the chart below and the space at the bottom of the page for additional comments. In each column, check all that apply.

Method for Applying Blanket Wash	**Type of Wipe Used to Clean the Blanket**	**Avg. No. of Wipes Used/Cleaning (cleaning+excess)**	**Method for Removing Excess Wash from Blanket**	**Wipes Management**
Use squirt bottle to spray directly on blanket ☐	**Disposable** ☐ Size:_____	1-2 ☐	Clean dry rag ☐	Send off-site for laundering ☐
Use squirt bottle to spray on wipe and apply wipe to blanket ☐	Wet ☐ Dry ☐	2-4 ☐	Clean wet rag ☐	Launder on-site ☐
Dip wipe in blanket wash and apply to blanket ☐	**Reusable** ☐	4-6 ☐	Allow to evaporate ☐	Dispose of as hazardous waste
Use safety plunger can ☐	Size:_____ Wet ☐ Dry ☐	6-8 ☐	No excess ☐	Dispose of as non-hazardous waste ☐
None Used ☐		8-10 ☐	Other (specify) ☐	
Other (specify) ☐	**Other** (specify) ☐	Other (specify) ☐		Other (specify) ☐

• Was the rotation of the blanket during washing *(circle one):* **manual** or **automatic**?

• Note any other steps taken in washing the blanket:

• For the current blanket wash product, ask the press operator if there are ever any variations in the cleaning procedure, and if so, under what circumstances?

8b. Cleaning Procedure - BASELINE PRODUCT

Clean the blanket using the baseline product, Naphtha, recording the required information on the observer's evaluation sheet for each cleaning.

• Note the condition of the blanket **before** cleaning:

• Weigh the Naphtha container before use. Record weight: _____

• Pour Naphtha onto a clean, dry wipe.

• Weigh the Naphtha container again. Record weight: _____

• Record the difference in weight on the evaluation sheet.

• Clean the blanket.

• Was the rotation of the blanket during washing *(circle one):* **manual** or **automatic**?

• Note any other steps taken in washing the blanket:

8c. Cleaning Procedure - SUBSTITUTE PRODUCT # _____

Clean the blanket using the substitute blanket wash. Follow the manufacturers instructions and record the required information on the observer's evaluation sheet for each cleaning.

• Note the condition of the blanket **before** cleaning:

• Describe the cleaning procedure:

• Was the rotation of the blanket during washing *(circle one):* **manual** or **automatic**?

D.2 OBSERVER'S PERFORMANCE EVALUATION SHEET

Facility Name_____Date _____

Demo Type: *(Check one and enter wash #)*
Current Wash _____ **Baseline Wash** _____ **Substitute Wash** _____ **(enter code # _____)**
Wash # _____ (1 - 3) Wash # _____ (1 - 5)

Ink used before wash-up	Specify ink color, type, and manufacturer: conventional .....☐ vegetable oil-based....☐ other (specify) _____
Run length	Record length of run (# impressions) _____
Ink coverage *(obtain a sample sheet for each level of coverage)*	*(check one)*: Heavy_____ Medium_____ Light_____
Substrate	*Record substrate printed:*
Drying time	Time from end of press run to start of blanket wash: _____ minutes
Dilution	_____ *(enter wash:water ratio* or *"none" if used at full strength)*
Quantity of wash used	_____ ounces *(pour wash on wipe; record volume of wash poured)*
Cleaning time	_____ minutes *(time for blanket cleaning only)* _____ rotations *(corresponding number of blanket rotations)*
Ease of cleaning	*(check one for each question):* • Compared to your standard wash, was the effort needed: Lower_____ Same_____ Higher_____ • Compared to the baseline wash, was the effort needed: Lower_____ Same_____ Higher_____ • Did the wash cut the ink: Well____ Satisfactorily____ Unsatisfactorily____
Excess wash	Did you have to remove excess wash? *(check one)* Yes _____ No_____ If "Yes", how was it removed? *(check all that apply)*: Wet wipe____ Dry wipe____ Allow to evaporate____
Wipes used	Enter the total number of fresh wipes used for blanket washing *(includes both wipes used for washing and for removing excess wash)*:

Odor	*(check one):* Odor not noticed_____ Odor detected_____ Strong odor_____
Printer's opinion of the wash performance?	The wash **performance** was *(check one):* Good_____ Fair_____ Poor_____
Examine the blanket	Evaluate the blanket appearance after the wash:
Printing after the wash	Specify the ink color and type used after the wash: How many impressions were run to get back to acceptable quality? _____ Does the printer think the wash caused problems with the print quality? Yes *or* No If yes, explain:

D.3 PRINTER'S EVALUATION SHEET

Facility name: _____ Date: _____

Press Operator's Initials: _____

Answer these questions for the BLANKET WASH ONLY (do not include the roller cleaning)	
Ink used before wash-up	Specify ink color: _____ Specify ink type: conventional.....☐ other_____ vegetable oil-based...☐
Run length	Record length of run: *# impressions =* _____
Ink coverage	*circle one*: Estimate the image coverage: Heavy Medium Light
Quantity of wash used for this cleaning	_____ # of ounces from Portion Aid dispenser provided
Cleaning rotations	_____ rotations *(record the number of blanket rotations completed during the blanket cleaning)*
Ease of cleaning	*circle one*: The effort needed to clean the blanket was: Low Medium High
Wipes used	Number of fresh wipes used for blanket washing: _____
What is your opinion of this blanket wash?	*circle one*: The wash performance was: Good Fair Poor
Examine the blanket condition after the wash	Is there any residue, debris, etc. on the blanket? Yes.....☐ No.....☐ If yes, please explain:
Printing after the wash	How many impressions were run to get back to acceptable print quality? Did the blanket wash cause problems with the print quality? Yes...☐ No...☐ If yes, please explain:
Comments or suggestions - Use the back of this sheet or the space below for any comments:	

D.4 END-OF-WEEK FOLLOW-UP QUESTIONNAIRE

End of Week Follow-Up to Lithographers

At the end of the week-long demonstration, contact the press operator who used the blanket wash either in-person or by phone. Interview the operator to determine if there were any problems, changes, or concerns since your visit. If you are contacting them by phone, remind them to send in the completed forms immediately.

Facility Name _____ **Substitute Wash #** _____

1. In your opinion, was the performance of the substitute wash better, worse, or about the same as your standard wash? Why?

2. Did you find any conditions where the wash did not work? (e.g., a certain ink type, ink color, or especially heavy coverage). If so, describe the condition(s).

3. Have you changed the appliation procedure in any way?
   - Do you use more wash?
   - Have you changed the dilution?
   - Have you changed the method for removing excess wash?

4. Do you think the number of impressions required to get back to acceptable print quality is greater, the same, or less than were required using your standard blanket wash? Why?

5. Did you use any other blanket washes during the week on this blanket? Why?

6. Note the condition of the blanket

7. Do you have any other comments, concerns or problems regarding the substitute blanket wash?

APPENDIX E
CATEGORIZATION FOR LITHOGRAPHIC BLANKET WASHES

Table E-1. presents the following categories and classsification of formulations that were developed by the DfE Lithography Project Core Group and reviewed by the blanket wash suppliers. The categorization was developed to assist with the development of the Performance Demonstrations.

Table E-1. Categories and Classifications of Formulations

Category	Mix	Washes	
		All	Pass[1] to Demo
1.	Vegetable fatty ester	1 26 29	1 26 29
1a.	Vegetable fatty ester (+glycol)	14 19	14 19
2.	Ester/Petroleum	3 21 36 38	21 36 38
2a.	Ester/Petroleum (+surfactant)	6 11 18 40	6 11 40
3.	Ester/Water	9 10	9 10
4.	Petroleum	31 32 35	31 32
5.	Petroleu/Terpene	13 15	13
6.	Petroleum/Water	5 8 20 37 39	20 37 39
6a.	Petroleum/Water (diluted for use)	12 30 33	30 12
7.	Water/Petroleum/Ester	22 34	22 34
8.	Terpene	16 24 27	24
8a.	Terpene (+ additives)	4 7 23 25	
9.	Detergent	17	

[1] indicates formulations passed blanket swell test (≤3.0%) and basic washability

APPENDIX F
COST OF ILLNESS VALUATION METHODS

Several approaches are available to estimate the economic benefits of reduced morbidity effects associated with pollution releases, including: contingent valuation, averting behavior, hedonic valuation, and cost of illness approaches. Table F-1 provides a brief summary of each.

Table F-1. Cost of Illness Valuation Methods

Valuation Method	Description
Contingent Valuation Approach	The contingent valuation approach uses a survey to illicit estimates of individual willingness-to-pay to avoid a given illness. The contingent valuation technique, when properly designed, should capture direct treatment costs, indirect costs, and costs associated with pain and suffering.
Cost of Illness Approach	The cost of illness approach estimates the direct medical costs associated with an illness and will sometimes include the cost to society resulting from lost earnings. Cost of illness studies do not account for pain and suffering, the value of lost leisure time, or the costs and benefits of preventive measures.
Hedonic Valuation Approach	Hedonic valuation studies use regression analysis to estimate the relationship between environmental improvement or reduced worker risk and other independent variables. For example, a hedonic wage study may attempt to describe the relationship between wage rates and job related risks (i.e, what is the premium required to compensate workers for the added risk they incur from their occupation). The weakness of the hedonic approach is based upon the difficulty in separating illness effects from other independent variables.
Averting Behavior Approach	The averting behavior method examines preventive measures undertaken to avoid exposure or mitigate the effects of illness. Investments made in preventive measures are then used as a proxy for individual willingness-to-pay to avoid a particular illness.
Source: Unsworth, Robert E. and James E. Neumann, Industrial Economics, Incorporated, Memorandum to Jim DeMocker, Office of Policy Analysis and Review, *Review of Existing Value of Morbidity Avoidance Estimates: Draft Valuation Document*. September 30, 1993.	